

THE DISTRIBUTION OF *PINUS BANKSIANA* LAMB. IN NEW ENGLAND AND NEW YORK

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THE NATURAL RANGE OF *PINUS BANKSIANA*

The range has been described in general terms by Sargent (1897), Bell (1897), and many others. Schoenike (1976) pointed out that jack pine has a southeast-northwest range of 4185 km in a belt up to 1600 km in width. It occurs over 23 degrees of latitude and 67 degrees of longitude. Fernald (1911, 1950) and Rudolf (1958) traced the northern limit from Nova Scotia and northern Quebec to the Northwest Territories at Lat. 65° in the McKenzie River Valley, and the southern boundary from Central Maine west to the Lake States, central Manitoba, Alberta, to northeastern British Columbia. Halliday and Brown (1943) published a map showing details of the range in Canada and suggested that the northern boundary is not limited by rainfall, but that it may be by temperature. Jack pine ceases to be found several hundred miles south of the northern tree limit, namely at the 14° C. July isotherm. Mirov (1967) stated that jack pine occurs in areas of warm to cool summers, very cold winters and low rainfall. It occurs farther north than any other pine. Critchfield and Little (1966) provided a more up-to-date map of the range. Schoenike (1962) surveyed the range in Minnesota.

Within such a wide range, provenance studies have shown clearly the existence of local races that are part of the continuum of clinal variation associated with climatic gradients. These have been reported by Rudolph et al. (1957), Williams and Beers (1959), Holst and Yeatman (1961), Schoenike (1962 & 1976, loc. cit.), Mergen and Worrall (1965), and Yeatman (1974).

RANGE OF *PINUS BANKSIANA* IN THE NORTHEASTERN UNITED STATES

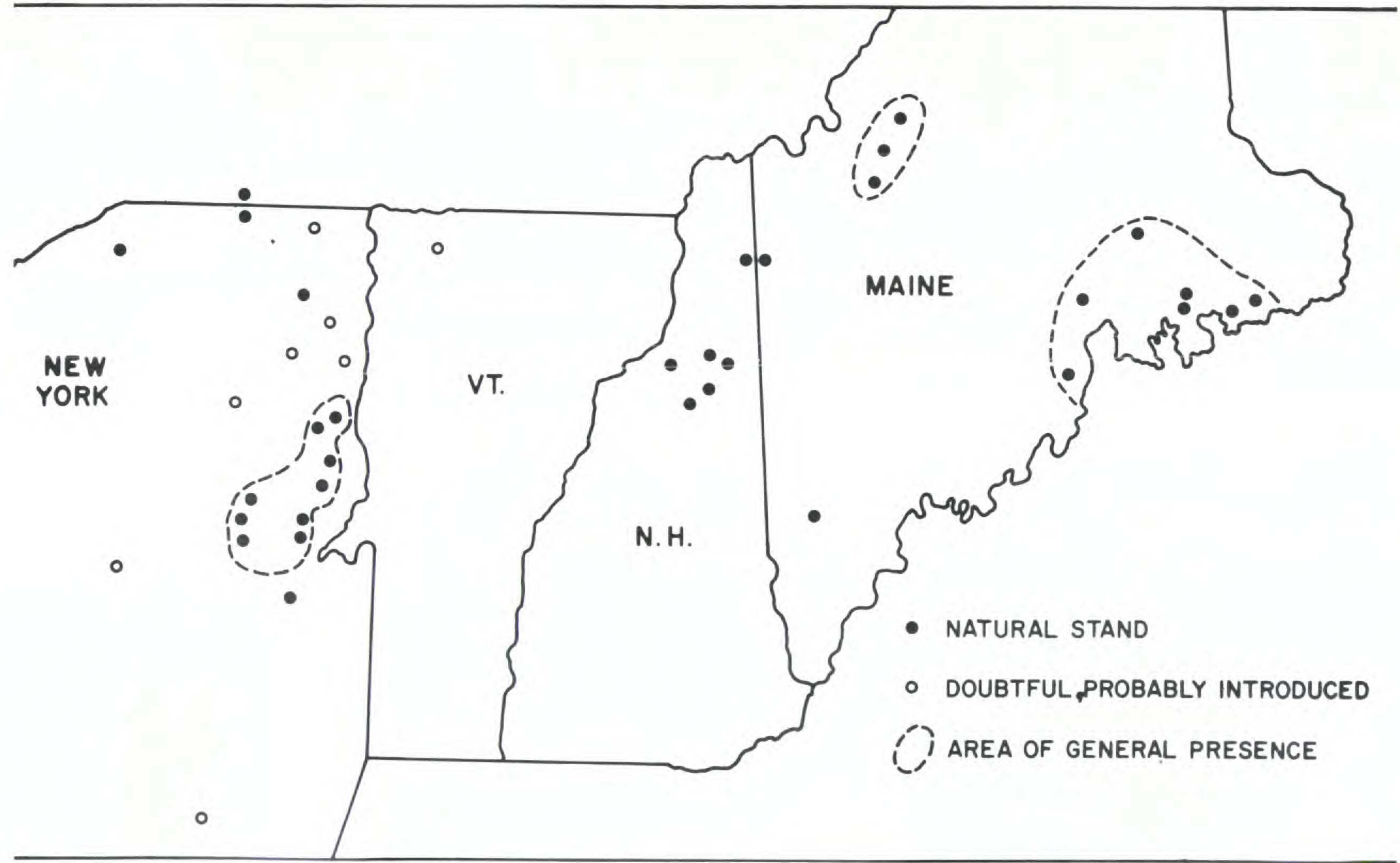
Range delimits the area within which naturally occurring trees are found. Fernald (1911, loc. cit.) defined the southern limit as a "line running from the east side of Penobscot Bay to the Rangeley Lakes, thence with a slight dip southward at the western edge of the White Mountains, and (then) across northern Vermont." The Vermont natural stands were thought to be extinct. The New York southern

boundary probably would be a line from southern Essex County to northern St. Lawrence Co. The northern boundary would run through Clinton Co. to the northern tip of St. Lawrence Co. In New England the northern line might run from Jonesboro, Maine northwesterly to Jackman, and thence to Rangeley Lakes, and west across the central White Mountains. Steele and Hodgdon (1968) characterized the occurrence of jack pine as "infrequent in northern and central Maine, rare in northern New Hampshire and Vermont, usually on ledges".

Report of outliers beyond this narrow belt have been found so far to be introduced trees. The most famous was the report by Harshberger (1914) of jack pine on Nantucket Island, refuted by Bicknell (1916) who showed that the trees were planted along with many other exotics as early as 1847 and 1888. Jack pine reproduces naturally from planted mother trees ("established escapes") and this may account for some of the reports and herbarium records from outside its natural range. Bramble (1946) described a case in Pennsylvania where jack pine reproduced abundantly following a fire that destroyed a mixed plantation containing a small proportion of jack pine. Weatherby et al. (1926) referred to jack pine as a local species in New England, with 5 stations on the coast of Maine, the Dead River Valley (Me.), Lake Umbagog, Thornton, N.H. and the headlands of Lake Champlain, "all, it will be noted, at low elevations".

The natural range was determined from (1) published accounts, (2) herbarium records, and (3) on the ground examination. It was difficult to separate introduced or "established escapes" from truly natural indigenous populations. Lowland and southern stations were suspected of consisting of introduced trees. Trees growing on high mountain ledges or rocky lake shores are unlikely to have been brought in by man. Where there is no convincing evidence of origin, no firm decision can be made. No records of natural stands in Connecticut or Rhode Island have been found. The investigation was made chiefly from 1958 to 1961. The present recorded distribution is shown in Fig. 1.

Figure 1. Stations for *Pinus Banksiana* Lamb. in New England and New York.



NEW YORK

Many of the general range maps (e.g. Hough, 1936; Munns, 1938; Little, 1971) showed all of northern New York in the range of jack pine. Actually it is limited essentially to Essex and Clinton counties and is very spotty in occurrence. Sargent (op. cit.) mentioned the Adirondacks, but he was evidently generalizing. Little (1953) and Rudolf (op. cit.) stated that it occurred up in the Adirondack Mountains to 610 m. Hough (op. cit.) included a picture of a jack pine in Essex County. Blakeslee and Jarvis (1911) traced the range through northern New York. Sears (1881) probably first pinpointed the locations at Altona, followed by Peck (1898) and House (1924). Littlefield (1928) gave detailed descriptions of natural jack pine stands. He described an interesting mixture of *Pinus Banksiana*, *P. rigida*, and *P. resinosa* near the village of Clintonville, Essex County. He termed jack pine quite common elsewhere in the Ausable River valley from Ausable Forks to Upper Jay. This is not far from the well-known stand in Wilmington. Pratt and Littlefield (1938) reported the discovery in 1931 of a group of jack pines on a sandy knoll on the east bank of Deer River in the Town of Brasher, St. Lawrence Co. This was within a mile of the Brasher Iron Works at an elevation of 73 m, 80 km west and northwest from the nearest stations in Altona and Wilmington. It was formerly thought to be limited to the counties mentioned, but Littlefield (1960) enumerated other stations such as New Russia on the Bouquet River, Wainwright Mt. and the northern spur of Poke-O-Moonshine Mt. at 457 m, all in Essex County. In Clinton County he reported it at Flat Rock near Schuyler Falls and Altona. A new station near Ellenburg Depot on both sides of the Canadian boundary was reported to Pratt and Littlefield in a personal communication from Frère Marie-Victorin (University of Montreal). This location was subsequently visited and reported by Littlefield (1960, 1962).

Sears (op. cit.) made some interesting observations on jack pine in New York. He called it quite a rare tree in New York, with "seldom more than four or five growing within 10 miles of each other". . . . "Solitary ones are more common." . . . "As to size, they are seldom over 8 feet high, although one was found in Altona 15 feet high and 8 inches in diameter, but this tree was partially decayed."

"This tree is known as the unlucky tree by the inhabitants. The more observant ones call it a cross between a pine and a spruce. It is considered dangerous to pass within 10 feet of its limbs, and more so

to women than to men. It is equally dangerous to cattle. So that whatever ill befalls a man, his family or his cattle, if there is one of these trees on his land, it must be destroyed — burned down by wood being piled around it — for no one would venture to cut it down." This was also quoted by Sargent (*op. cit.*, p. 149). No one has suggested this superstition as a reason for the rarity of jack pine, or its presumed disappearance from places where it formerly grew.

VERMONT

Older range maps show the range of *Pinus Banksiana* covering northern Vermont (Hough, *op. cit.*; Munns, *op. cit.*), some almost one-half the state. However natural stands appear to have been very rare. Sargent (*op. cit.*) stated that about 1860 a small grove was found near Ferrisburg in Addison County by Rowland E. Robinson of Ferrisburg. Blakeslee and Jarvis (*loc. cit.*) reported jack pine at Monkton and Starksboro, Addison Co. and at Fairfax in Franklin County. A few trees were found at each station on rocky slopes and on sandy soil. The same stations were listed by Burns and Otis (1899, 1916–1924). Little (1953, *op. cit.*) and Rudolf (*op. cit.*) state that it was local in occurrence in Vermont. Seymour (1969) listed only Fairfax in Addison County. Schoenike (personal communication, 1959) was unable to locate any of the stations in Vermont. Recently, Little (1971, *op. cit.*) showed on his range map crosses indicating that he believed jack pine to be extinct in Vermont. However, Professor H. W. Vogelmann of the University of Vermont reported to me that one of his students had brought in a specimen on March 31, 1977 from a stand near Hygate Center, east of Swanton on Route 78. I visited this station in May 1978 and found several small groups of jack pines from small saplings to trees 30 years old. I interviewed several residents of the area, and concluded that all the jack pines had originated from a 50-year mixed conifer plantation that contained a few jack pines.

MAINE

This species is much more widely distributed and more common in Maine than in other Northeastern states. Rand (1889a, 1889b) reported it on the coast. Hyland (1946) called it "frequent locally, and rather plentiful on barren, sandy or rock soils in central and eastern Maine, and apparently absent from other sections." Blakes-

lee and Jarvis (loc. cit.) reported it from Traveller Mts. and Grand Lake. Fernald (1911, loc. cit.) described the southern limit as a line running from the east side of Penobscot Bay to the Rangeley Lakes. Peirson (1951) gave the most southern point as Ossipee Mt. in Waterboro. Coburn (1920) gave detailed descriptions of large stands near Attean Lake. Seymour (1969, loc. cit.) mentioned Orrington, Heron Lake and Jonesport, and Ogden et al. (1948) listed seven counties where it is found. Norton (1913) found it on the coast and on islands and Pike and Hodgdon (1963) found it on Great Wass Island.

MASSACHUSETTS

A number of specimens collected in Massachusetts are to be found in herbaria. Many of these were found in the vicinity of Boston, and either are noted by the collector as coming from planted trees, or are suspected of being non-indigenous. The late Dr. Stuart K. Harris collected from a number of places in the state. In his *Flora of Essex County*, he listed *Pinus Banksiana* under "species exclusae" because it was probably introduced. Other noteworthy collections include a specimen in the herbarium at Clark University from Uxbridge, described by the collector as coming from "a large colony, from seedlings to large trees; both sides of the Quaker Highway, possibly an established escape". The University of Massachusetts herbarium contains one from Deerfield, "Pole Swamp Road, below the shack". The long-standing conclusion by Fernald and others that *Pinus Banksiana* was limited to northern New England and New York casts doubt on these reports from southern New England. However, they demonstrate that jack pine becomes established easily where the habitat is congenial. Russell R. Walton has recently told me of several small stands on Martha's Vineyard. These were probably introduced originally, but now have escaped and become established.

At the invitation of Mrs. Mary Walker of Concord, Mass., I visited the so-called Smith Grant area in Southern Winchendon; there are several hundred jack pines growing in an area of about 5 acres around a cranberry bog and on adjacent eskers and hillsides. The pines range from small saplings to trees which are 50 ft high, 12" in diameter, and about 50 years old. There are also some stunted, crooked, branchy trees. How the seed reached the area is a mystery;

Mr. Lambert, of the Mass. Conservation Department, suggests that it might have blown from a plantation on the Otter Brook State Forest, but why pine did not colonize intervening areas cannot be explained.

NEW HAMPSHIRE

Jack pine is the rarest natural pine, occurring in several isolated mountain stations in the White Mountains and along the shores and on some islands in Umbagog Lake. Discovery of jack pine seems to have been recorded earlier than in most other states. Huntington (1884) reported: "There was also found on Welch Mountain the gray scrub pine *Pinus Banksiana*. This thought to be farther south than any point where it has been previously seen." Following this, Sargent (loc. cit.) mentioned Welch Mountain as the only station in New Hampshire as did Fernald (1919): "In New Hampshire the species is only on Welch Mountain, a sterile granite mass south of the syenitic Franconia Range."

Welch Mountain, Waterville, 790 m

This is not only the largest assemblage of jack pines so far discovered in New Hampshire, but the earliest reported. Pychowska (1891) wrote "My sister, Miss Edith W. Cook, found sundry stunted specimens of *Pinus Banksiana* on the mountain top August 9, 1881." Miss Cook was an active botanist in the White Mountains at that time. It is significant that she found only "sundry stunted specimens" indicating that there were very few trees there. Foster (1931-1946), a citizen of Waterville, wrote of jack pine: "On Welch Mountain, Waterville, there are low clumps of it near the summit." Perhaps Foster was referring to conditions he saw on an early ascent. He was an active climber, and must have climbed Welch Mountain many times. The population increased with passage of time. Jenks (1934) stated that Edward W. Littlefield had told him that the pine had spread from the few trees seen by Cook and by Littlefield in 1923 to a large stand at that time. By 1950 the whole upper part of the mountain had become abundantly sprinkled with jackpine wherever a crack in the rocks afforded a root hold. This may be taken as evidence that the number of trees and the area occupied have increased. The cause may lie in the fact that the

mountain offers so much bare area for exploitation. There are as yet few competitors. Spruce has taken over the sheltered hollows, along with some white pine, but jack pine is not hindered elsewhere. The entire summit and the eastern and southern flanks of the mountain down to the top of the steep cliffs on the eastern side are now covered by this species. There is an almost pure stand of jack pine on the summit where it was first reported.

The mountain must have been swept by a severe fire many years ago that completely destroyed all soil. Thomas Starr King (1862), probably referring to observations several years previously, refers (page 94) to Welch Mountain as "being nearly destitute of forest covering, and showing large masses of bare quartz (sic.); it presents very beautiful and striking harmonies of the grays and neutral hues of blue and white and at sunrise and sunset exhibits proportional increase of splendor."

The only fires of record are one in 1933, and possibly one in 1923. Revegetation after the original fire is still progressing rapidly as demonstrated by young spruce and white pine on the rocks of nearby Dickey Mountain. Many of the older jack pine on Welch Mountain are leaning or have prostrate stems, possibly felled by the 1938 hurricane, since they are slanted toward the northwest. These have remained alive because part of the root system remained in the soil or cracks in the rock, and now side branches have grown into erect trees. Cones are still borne on twigs in contact with the bare granite, or slightly above it. These may be subject to high temperatures in summer, high enough, it may be, to open the cones and release seeds more plentifully than before. Schoenike (1959 personal communication) sampled 20 trees on Welch Mountain and found that they were predominantly of the open cone type, common in southern populations as shown by Schoenike (1976, *op. cit.*).

Dickey Notch, Thornton 520 m

While following the open rocky ledge southwest from the top of Dickey Mountain on October 8, 1958, I discovered a single tree on the edge of the cliff above Dickey Notch. It was a small tree about 20 years old and may have originated from seed blown from Welch Mountain over a mile to the east. It is noteworthy that no jack pine was found in the intervening area, nor on Dickey Mountain or on the ledges to the westward. (Baldwin 1961)

Bog Pond, Lincoln, 750 m

On July 11, 1975, Mr. Frederic L. Steele's son discovered one tree "about 13 years old in a swampy area under the power line and south of a shack". (Steele, personal communication, 1977). Specimens are in Mr. Steele's private herbarium.

Carter Ledge, Mt. Chocorua, Albany, 700 m

The trees occur in a limited area of open ledge about 1.6 ha in extent. Bare granite ledges slope rather steeply to the southwest. The trees seem to have been discovered August 31, 1935 by Arthur C. Comey. The following day Alexander Lincoln collected specimens. Comey (1936) published an account of the station with a photo taken by Lincoln. It appears that jack pine became established here after a fire over 100 years ago consumed all the original soil. Some of the trees grew in cracks in bare rock on the summit ridge; a few were mingled with red spruce and white pine on a thin duff soil that accumulated on the bedrock.

About 100 trees were found in the area; most were bent, depressed and crooked, typical of timberline trees in exposed locations. Some were once erect but had become bent by ice and snow. The only straight specimens were on the ridge top mixed with spruce. One of these measured 15 cm at breast height and showed 65 annual rings at that point in 1958. A deformed and nearly prostrate tree near the top of the ledge was 20 cm in diameter and had 45 rings. Nearby a tree about 1.5 m high had 27 rings at the stump. This suggests that it takes a long time to reach breast height (1.3 m) on this adverse site. If jack pine invaded the area soon after the fire, it has evidently reproduced actively since. There were numerous small seedlings in cracks in the rock. On the other hand it is questionable if the species is now increasing, since red spruce and other trees and shrubs are encroaching on the pine. Away from the open ledge jack pines were already overtopped by spruce.

Mt. Webster, Hart's Location (Three separate stations)

This great west-facing wall rises abruptly above Crawford Notch and extends more than two miles north and south. There are smooth steep slides and equally steep talus slopes of more recent origin. The intermediate areas support stands of small spruce trees, paper birch and other northern hardwoods.

Station 1, 915 m This single tree was discovered by Steele and Lincoln (Steele 1954) on November 13, 1953, the first found in this area. Crossing the Saco River considerably upstream from the Willey Site they followed a steep couloir almost to the top of the ridge. Descending slightly they saw a single tree on the slope above and to the northwest of them. It was about 5 m high and the trunk was ellipsoidal in cross section just above the ground level with diameters 9–14 cm. There was no other vegetation in the area.

Station 2, 900 m While looking for this tree in October 1961, I found an "island" of vegetation about 5×7 m, halfway up the cliff on a very steep slide. This contained five jack pines 5–15 cm in diameter at breast height. One was apparently very old with a prostrate stem, bent down by avalanches, from which a curiously deformed branch of elliptical cross section supported long creeping branches spreading over the rock. Associated plants on this "island" were an interesting mixture of northern and southern taxa: *Vaccinium*, *Vitis*, *Idaea* var *minor*, *Potentilla tridentata*, *Ledum groenlandicum*, and northern trees; also warm site or southern species *Cornus alternifolia*, *Quercus rubra*, *Tsuga*, *Juniperus*, *Arctostaphylos*, *Rubus*, and *Thalictrum*.

Station 3, 976 m Searching the slope farther south, I found a rather large stand near the summit of the cliffs south of a newly formed avalanche gully of talus, across from the Willey Site State Park. I estimated the stand to contain no less than 500 trees (Baldwin, 1961, op. cit.). Increment cores taken at stump height showed that the trees ranged from 70 to 96 years old. Trees were 15–30 cm at breast height and 3.7–12 m high.

Lake Umbagog, Errol, Coos County, 380 m

This has been a favorite collecting ground for botanists, but few have identified the place of collection accurately. Hodgdon and Steele (1958) describe the area of jack pine as "the vicinity of Lake Umbagog; all New Hampshire stations are on ledges". Many collectors were uncertain whether they were in New Hampshire or Maine. As on Welch Mountain, Schoenike (1959, personal communication) found 45% of the trees at Umbagog to be of the open-cone type and 20% closed-cone types.

Tyler Point. The most northern tree on the lake (and in New Hampshire as a whole) was one tree on the northern promontory,

on a ledge at high water mark. This was on the south side of the point. No trees were found on the west facing shore; but to the south of Tyler Point, on a small rocky arm about midway from the state line to the point, I found a considerable colony of 75 to 100 trees. These were mostly young trees; the oldest and largest, nearly 30 cm in diameter, had been blown down and were prostrate, but still alive. Branches were growing erect and bearing cones. There was charcoal on a dead basal branch, and evidence of fire on stumps in the forest back from the shore. Many seedlings less than 30 cm high were growing in cracks in the bare pink granite.

Schoenike (1959, personal communication) reported finding a few scattered jack pines growing on a low east-facing sandy slope about 4.8 km north of Upton, Maine. He writes: "South of Camp Gordon and inland is the largest stand I saw, perhaps several hundred trees up to 40 cm d.b.h. and 18 m tall, quite dense, but not reproducing. This extends from near the lake shore up a hill to perhaps 120 m or more inland. It can be reached by trail on the Maine side of the lake."

Tidswell Point. The shore opposite the island near the tip of the point, southwesterly to the state line, was well populated with scattered jack pines, some of considerable size. Some trees were inland 15 m or more, but most were directly on the shore. This was the largest area containing jack pine that was found, and the only place on the lake where jack pines were present on a west exposure. On the south shore of a bay opposite the island nearest the point proper was a stand growing in marshy lowland. The soil was sand and the pines were being overtopped by paper birch. The greater size and age of trees along this shore suggest that this station may have been a seed source for colonization of the outlying groups of trees farther north on the lake.

Bear Island. This island of about 2 ha is heavily wooded with white pine, red spruce, hemlock, northern white cedar, and paper birch. The shores are low and marshy with a dense scrubby fringe of *Myrica gale*, *Spiraea latifolia*, *Cornus stolonifera*, *Viburnum dentatum*, *Viburnum cassinoides*, and *Alnus rugosa*. On the south shore, growing among these shrubs on wet sandy soil, were seven jack pines about 15–20 cm d.b.h. and 4.5–6 m high. They bore cones of several years, but no younger trees could be found. No age determination was made, but probably none of the trees exceeded 50 years, and

most appeared one-half that. There was no evidence of fire on the island, which was uninhabited.

Metallak Island. This is the northernmost island where jack pine was found. Less than 0.8 ha, it has been extensively altered by man and contains the ruins of a large building that burned many years ago. Eleven huge white pines and one red oak form an impressive ring in the center. There were two pine stumps and two oak stumps in the same grove, the latter cut by beaver. White pine and northern white cedar formed a thicket around the shore, and in the southwest corner of the island were fourteen 20-year old jack pines in an area about 4×15 m. The jack pines are not on ledge, but growing in old sod land with shrubs such as low bush blueberry, meadowsweet, and speckled alder. One dead jack pine was also found. The radial growth rate of the living trees was 6 annual rings 2.5 cm. A few of the pines appeared to have been defoliated, possibly by sawflies.

Lone Pine Island. This is the name I have used to designate a small island south of Bear Island and west of Blake Island. It is about 18 m in diameter with one very large white pine in the exact center of the island. Its roots have been washed bare and eroded by ice but are anchored securely in crevices of the ledge forming the island. Surrounding the large white pine were 44 jack pines varying in size and age from 2-year seedlings to 15 cm d.b.h. and about 50 years old. The largest jack pine, nearly prostrate, with the base of the trunk decayed on the upper surface, was over 100 years old. Branches had grown erect into what appear like separate trees. This tree may be the immediate progenitor of the other trees on the island, although seeds may have blown or drifted from the mainland. Jack pine here was growing in pine humus, not directly on open ledge. The other vegetation of this island consisted of one white spruce, several small white cedars and red maples, and ericaceous shrubs.

Islands Southwest of Tidswell Point. These contained numerous jack pines, apparently fairly young and growing on the south shores and under larger white pines. Two large jack pines are on the southernmost island. They measured 33 cm and 43 cm d.b.h. and were approximately 110 and 150 years old respectively. On the mainland opposite these was one jack pine 66 cm in diameter and about 137 years old. These trees may have antedated the large forest fires that swept the mainland, burned stumps remaining as evidence.

Other Islands. Blake Island and the one east of it were examined and no jack pine found. The same was true of Black Island, Big Island and the islands associated with it.

The West Shore. Only one tree has so far been found on the west shore north of Sargent Cove and in the Town of Errol.

Islands near the state line opposite Sargent's Cove. Numerous jack pines 15–20 cm d.b.h. were observed on the shore but not investigated further. It is possible that some of these may be in the Town of Cambridge.

DISCUSSION

FACTORS AFFECTING THE DISTRIBUTION OF *PINUS BANKSIANA*

Irregular or disjunct distribution has always puzzled plant geographers. Plants are certainly limited by extreme environments. Northern extension of trees is prevented by short growing seasons and insufficient heat to ripen seed. Since jack pine is a northern tree some authors have postulated that high temperature limits its southern migration, but it seems to thrive when planted far south of its natural range. Jack pine inhabits the hottest and driest sites, often bare rock ledges where summer temperatures must be high. This habit may be attributed more to lack of competition. It is found on the driest and most sterile soils in northern Canada where it becomes established in pure stands following fire. However fire is not necessary for the perpetuation of jack pine ecotypes having a high percentage of open cones. These types release some seeds in the fall when cool temperatures prevail. In these trees, repeated wetting and drying has more to do with seed release than temperature. Bare mineral soil occasioned by fire is not a prerequisite for germination and survival. Exposed loose duff is a poor seedbed since it dries out quickly. However, damp organic matter can provide a satisfactory substrate.

Hutchinson (1918) considered temperature one limiting factor but concluded that soil conditions must be the real cause restricting the presence of jack pine. Fernald (1919, op. cit.) presented evidence that *Pinus Banksiana* is absent from limestone areas and is found only in acid habitats. Schoenike (1962, op. cit.) found no jack pine on heavy clay, bogs, or hardwood types in Minnesota. Pease (1921) confirmed Fernald's observations but pointed out that jack pine was actually found on a wide variety of sites. Halliday and Brown (op.

cit.) stated that jack pine reaches its maximum size on basic soils in western Canada and is found on limestone in Manitoba, the Bruce Peninsula and Manitoulin Island. Stebbins (1935) also found jack pine and red pine in Ontario, where he was impressed by the contrast between boreal and southern types of the same association. This was made even more remarkable by the presence of calciphiles and acid-loving plants, both equally at home. Possibly jack pine limestone ecotypes have developed in these cases. But there is general agreement that jack pine is found on barren, sandy and rocky soil probably because it is best able to compete with other species there. Jack pine has outgrown red pine and scotch pine (*Pinus sylvestris* L.) where all were planted together on sterile sand and gravel. The same controlling effect of site can be seen in swamp-enduring species and those tolerating salt, alkali, or acidity. Such species tend to be uncommon with disjunct distribution, since suitable sites are irregularly distributed. Griggs (1940) concluded that (1) a species is rare because it cannot compete, (2) rare species occupy habitats in early stages of succession, and (3) rare plants have disrupted ranges that were once continuous. They tend to be slowly dying out. Nothing could better describe the distribution of *Pinus Banksiana*. Past climatic changes and migration following glacial retreat are probably important factors in disjunct distribution, especially of pioneer species. Why it is found on some sites and absent from closely adjoining and apparently equal habitats defies explanation. Palmgren (1929) reasoned that chance, as expressed in the ecological history of a particular site, and the occurrence of a major disturbance are ecological factors to be considered.

A second noteworthy fact is that the great majority of trees found in both New York and New Hampshire are rather young, younger than any recorded fires that denuded the mountains where they occurred in New Hampshire, or overgrown pasture land where they are most abundant in New York. Exceptions are a few large old trees on the shore of Lake Umbagog. If Brewster found jack pine on Metallak Island in 1896 as the herbarium specimen indicates, why did we find only 20-year old trees in 1958 on the same place? Probably the older trees were blown down and burned.

The migratory history of jack pine has been thoroughly surveyed by Yeatman (1967). He concluded that during the late Wisconsin jack pine was forced south along with other boreal plants and survived in one central refugium in the Appalachian highlands. He

cited authors who reported jack pine fossil deposits from the glacial period as far south as South Carolina. With the retreat of the continental ice, jack pine was among the early pioneer species in post-glacial forests on outwash sands and gravels, as well as on exposed ledges on the high mountains. As more shade-tolerant trees invaded the soils protected by jack pine, only lightning fires ensured reproduction of jack pine on most sites. It is of interest that a lightning-caused forest fire occurred in 1953 on Mt. Webster not far from the jack pine stations there. The role of fire was more important in eliminating competition than in cone-opening. Later advance of mesophytic forests eliminated jack pine from all but a few stations in the northeast. With continued absence of competition from tolerant species such as on rocky situations of low fertility, jack pine can be self-perpetuating indefinitely with or without fire. Where these conditions do not obtain it is likely to become extinct in its remaining outposts.

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